SOME NEW METHODS OF MODIFYING MILK*

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Cow's milk is the only one that I shall consider in this paper, because the only one available in the United States.

Goats' milk is said to approach human milk much more closely in composition; goats are seldom subject to tuberculosis, and are cheaper to procure and maintain than cows, yet goats' milk is not a commercial article. I doubt if any of us have even known an instance of its use.† Perhaps their destructiveness weighs too heavily in the balance. The object of modifying milk is to imitate human milk, by adding to and taking from its ingredients. To create a synthetic human milk, as it were.

The first method was by the percentage system, originated by Rotch, I believe, and while not entirely successful, has been the basis for all further investigations.

As the quantities of fats, proteids, carbohydrates, salts and water were approximated to those of human milk, it was still found unsuitable for many infants, because the system dealt only with quantities, and as Dr. Jacobi, the noted specialist, has said, "you may percentageize, peptonize, Pasteurize, sterilize, Walker-Gordonize all you wish, but cow's milk is not like human milk," for the difference lies in the chemical qualities, as well as in the relative quantities of the food principles.

I shall not speak of the ordinary percentage and top milk methods of modification, so clearly set forth in any of the very useful small volumes to be had on the subject of infant feeding, but of several more recent methods not generally given in nursing text books and magazines.

But I must not omit a few words on the passing of Pasteurization and sterilization, as routine measures. One reason for their disuse

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† [In 1893, or about that time, the late Dr. W. W. Jaggard of Chicago used goat's milk for his baby. The goats were kept in his garden, and were a source of much interest to the passer-by. He considered the plan a simple and practicable one, and urged all his patients, who used artificial feeding for infants, to purchase goats.—Ed.]

is their abuse. The lactic acid ferment, being destroyed by heat in these processes, there is no appreciable change in odor or taste to warn one, so that a very stale milk may be used unknowingly. Again, some people look upon sterilization and like measures as mysterious proceedings, which render substances so treated, incapable of ever being contaminated again, and they are more careless in handling this milk than with the ordinary product, with whose qualities and habits they are more familiar.

Then, too, these milks have been found less digestible and causing scurvy, but they are indicated in certain conditions, as: 1, When travelling. 2, In very warm weather. 3, When ice is unobtainable. 4, When there is doubt as to the cleanliness of the only available milk supply. Condensed milk is sterilized and may be had unsweetened, which removes one objection to its use. It is indicated under similar conditions, and it is a good plan to have several small cans on hand for emergency use, if one is situated where the delivery of milk may be delayed. It is diluted with boiled water to the strength of whole milk, as directed on the can, then made up by the formula in use. If not necessary to use the entire contents of the can, do *not* use the remainder later.

It is now thought best to get a certified milk and sterilize everything else except the milk when handling it. This is productive of good results, and my own experience has shown me, in repeated instances, that the milk will keep perfectly sweet for seventy-two hours, if this care be used.

The chief difficulty in the digestion of cow's milk is in the proteids, which are not only in excess of those of human milk, but also differ greatly in their chemistry. Now the proteids of milk consist of: 1, Casein. 2, Lactalbumin. Lactalbumin is not coagulated by acid or rennet, therefore is not acted upon in the stomach, but passes, in liquid form, into the intestine, where it is easily taken up and assimilated. Casein is the bug bear. It forms curds by the action of pepsin in the stomach.

The proteids of cows' milk consist of about one-fifth lactalbumin and four-fifths casein, while in the human milk the proteids show a reversed order of about three-fourths lactalbumin and one-fourth casein.

You can readily see the difficulty of these quantities, for if you dilute cows' milk to reduce the casein to the proportions of human milk, you also reduce the nourishing and easily digested lactalbumin in like measure, and as there is no accessible means of supplying it, the child suffers from under-**feeding.**

Beside this, the casein of human milk forms a fine, flaky curd, while cows' milk gives a coarse, tough curd, at which the stomach often rebels

and the intestine receives the masses almost as a foreign body; so the child suffers from their irritating action as well as the loss of nourishment contained in them, for the casein is a highly nourishing part of the milk.

So it would seem that cows' milk is a very poor substitute for human milk, but being all that we have, for I believe it is generally conceded that the proprietary foods cannot displace milk, many minds have worked to make the best of it, and one of them evolved the idea of whey feeding.

Whey is the pale yellow, watery fluid which remains when the proteids of milk are coagulated in the natural souring of milk, due to lactic acid. It contains all the nutriment of the milk except the casein (*i.e.,* the curd) and the fat. Whey is artificially produced by the addition of liquid rennet or essence of pepsin to the warmed milk.

You remember that the casein is coagulated by the rennet or pepsin, and can then be removed, while the lactalbumin is unaffected by these substances and remains liquid in the whey; hence its advantage as a diluent in cases of weakened proteid digestion. As the fat is removed by this process, it must be added afterward, in the form of cream, to supply the deficiency.

But "there is no rose without its thorn" and the prolonged use of whey, by its very ease of digestibility, panders to the weakened digestive apparatus, which remains undeveloped from lack of exercise. However, whey has been given for several months, with no ill effects, and is often a valuable bridge to cross the stream.

In making whey, the milk is brought to a temperature of 98.5 degrees F. A little salt having been added, it is poured into a warm bowl, that the temperature may not be materially reduced, liquid rennet or essence of pepsin is added, one teaspoonful for each pint of milk, the whole gently stirred to mix thoroughly, then set in a moderately warm place, where it will not be jarred or suddenly chilled. In a few minutes it should be firm. The jelly-like mass is then broken up well, and strained, and the liquid returned to the fire and brought to 150 degrees F. and maintained there a few minutes, stirring well, that the whole quantity may be of the same temperature, then strained again and it is ready for use, cream, sugar and water being added as per directions. The second heating kills the ferment which would, otherwise, continue to coagulate the added cream, even in the child's stomach.

This mention of temperatures sounds complicated, but the whole process is simplified if a dairy thermometer be used, which can be had for twenty-five cents, and eliminates all guess work. It is very annoy-

ing, when one has much to do, to find that the curd has not set when one is ready to prepare the food mixture, or to learn that one has not guessed 150 degrees F. correctly, when one finds a hardening mass during the second heating, for you know what effect a higher temperature will have upon the albumin in the whey, or again to see the separate feedings coagulating, after the cream has been added, showing that the temperature has been too low.

Since the fat is removed in the process, skimmed milk is quite as good as whole milk, for making whey, and much cheaper.

Less rennet than one teaspoonful to the pint will suffice, where two or more pints are being used.

Liquid rennet costs twenty-five cents for a three ounce bottle, but may be purchased at wholesale rates, about one-half price, in lots of one-half or one dozen bottles. All these things are to be considered, for whey feeding is not a cheap method. Milk yields about twenty-five ounces of whey from the quart, but the amount may vary slightly. If a few more ounces are needed, it is possible to add boiled water *to the whey*. To add to the milk first may prove disastrous, nor is it exact. Sugar should also be added to the whey or food mixture. It is not accurate to add to the milk first.

When the child is tolerating cream in quantity approximating that of an ordinary top milk or percentage formula for its age and weight, the whey is reduced by withdrawing several ounces from the whole mixture, from time to time, and supplying an equal amount of skimmed milk and boiled water, until no whey is used and the desired formula is obtained. The proportions of milk and water needed will require a nice calculation. Sufficient time should elapse between each reduction to permit the child to become accustomed to the modification.

It is safer, when making the change, to approach a formula for a child rather younger and weaker than the one in question, increasing when the adopted formula is operating well.

Another method of feeding is by the use of butter milk. This has been an established thing in Holland and other European countries, among the laity, for some time, but recently has been recognized by medical men as a valuable source of food for infants. It is cheap, therefore adapted for use among the poor. It has an acid taste and reaction due to lactic acid fermentation. This would seem far from being a suitable food, but it does agree with some infants who have not thriven upon sweet milk preparations.

The advantage seems to lie in that the casein is already precipitated in small, soft curds and the lactic acid prevents further bacterial fer-

mentation. The proportions of fats and proteids are about the same as in skimmed milk, but, in spite of this, it does not cause rachitis or scurvy.

It may be given pure or diluted with boiled water to varying extent. Cream or sweet milk may be added when conditions warrant it. In preparing buttermilk, one or more tablespoonfuls of sugar and one tablespoonful of some fine cereal flour are usually added to the quart, the whole slowly brought to the boiling point, *stirring constantly,* then poured into sterilized bottles and stoppered. In reheating the separate feedings, care must be used not to bring above body heat, as buttermilk coagulates easily when heated.

The most recent method of overcoming the proteid difficulty is by the addition of Sodium Citrate. This prevents the formation of hard dense curds by some complex, chemical combination. One to three grains of Sodium Citrate, for each ounce of whole milk, are added.

This method is usually begun with equal parts of milk and boiled water, or even greater dilution, then quickly brought up to whole milk. This rather upsets the percentage idea but seems the simplest and most satisfactory modification known. The advantages are: 1, It renders the curd more easily digested, so that larger proportions of milk can be taken. 2, It is cheap. 3, It is convenient to handle. A solution is made up of such strength that one teaspoonful contains the amount of Sodium Citrate needed for one feeding. This is added to each bottle just before feeding. This simplicity of application recommends it for the use of the ignorant. Of course, as the milk is increased, the solution must be made stronger. Among the more intelligent, powders are ordered of known strength, and the solution made up from time to time, according to requirements. 4, The solution of Sodium Citrate ordered, satisfies the desire for medicine, which many mothers show. It does not seem sufficient, to them, that the sick baby should have only its diet looked into.

The Sodium Citrate modification is indicated when weaning infants for any cause, for the one or more artificial feedings, usually given to breast babies, daily, and in correcting the proteid dyspepsia shown by loss of weight, habitual vomiting and offensive stools containing curds.

When tolerance for whole milk is established, it is customary to cut down the Sodium Citrate, gradually, though it is sometimes used throughout the whole period of milk feeding.